

Markings to Show Changes Made. For the Examiner's convenience, all of the currently pending claims, whether or not amended, are reproduced below.

2. A multifunctional device, comprising:
a platform,
a lighting element disposed on the platform, the lighting element having a lighting function and having at least one non-lighting function, and
at least one processor for controlling the lighting element to provide the lighting function and the non-lighting function, wherein the processor generates a pulse-width-modulated signal to control the lighting function.
3. A device of claim 2, wherein the lighting function is provided by LEDs.

5. (Amended) A multifunctional device, comprising:
a platform,
a lighting element disposed on the platform, the lighting element having a lighting function and having at least one non-lighting function, and
at least one processor for controlling the lighting element to provide the lighting function and the non-lighting function, wherein the processor generates a pulse-width-modulated signal to control the lighting function, and
wherein a period of the pulse-width-modulated signal is controlled using a duty cycle based on logic of exclusive or.

6. (Amended) A multifunctional device, comprising:
a platform,
a lighting element disposed on the platform, the lighting element having a lighting function and having at least one non-lighting function, and

at least one processor for controlling the lighting element to provide the lighting function and the non-lighting function, wherein the processor generates a pulse-width-modulated signal to control the lighting function, and

wherein a duty cycle of the pulse-width-modulated signal is controlled to provide the non-lighting function without visible effect on the lighting function.

10 (Amended) The device of claim 1, wherein the second non-lighting function positions the device.

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end 11 (Amended) The device of claim 10, further comprising a third non-lighting function, wherein the third non-lighting function comprises a sensing function and wherein positioning the device is in response to a sensed condition sensed by the sensing function.

8. (Amended) The device of claim 11, wherein the second non-lighting function is a sensing function.

9. (Amended) The device of claim 8, wherein the sensing function is provided by an element selected from the group consisting of a sensor, an IR detector, a camera, a motion detector, a proximity detector, a photovoltaic sensor, a photoconductive sensor, a photodiode, a phototransistor, a photoemissive sensor, a photoelectromagnetic sensor, a microwave receiver, a UV sensor, a magnetic sensor, a magnetoresistive sensor, an ozone sensor, a carbon monoxide sensor, a smoke detector, a position sensor, a thermocouple, a thermistor, a radiation pyrometer, a radiation thermometer, a fiber optic temperature sensor, a semiconductor temperature sensor, and a resistance temperature detector.

10. A device of claim 2, wherein the non-lighting function is an emitting function.

b2 11. (Amended) A multifunctional device, comprising:
a platform,

a lighting element disposed on the platform, the lighting element having a lighting function and having at least one non-lighting function, and

at least one processor for controlling the lighting element to provide the lighting function and the non-lighting function, wherein the processor generates a pulse-width-modulated signal to control the lighting function, and

the device further having at least a second non-lighting function selected from the group consisting of a communication function, a positioning function, a sensing function, an actuation function, an emitting function and a networking function.

12. A device of claim 1, further comprising a second device having a lighting function and a non-lighting function and further comprising a communication pathway among at least two such devices.

13. A method of providing multiple functions in a multifunctional device, comprising:

providing a platform,
disposing a lighting element on the platform, the lighting element having a lighting function and having at least one non-lighting function,
providing at least one processor for controlling the lighting element to provide the lighting function and the non-lighting function, and
generating a pulse-width-modulated signal to control the lighting function.

14. A method of claim 13, further comprising providing at least a second non-lighting function selected from the group consisting of a communication function, a positioning function, a sensing function, an actuation function, an emitting function and a networking function.

15. A multifunctional device, comprising:
a platform,
a first element disposed on the platform, the first element having a lighting function,

a second element disposed on the platform, the second element having a non-lighting function, and

at least one processor for controlling the first and second elements, wherein the processor generates a pulse-width-modulated signal to control the lighting function, wherein the lighting function is provided by LEDs, and wherein the period of the pulse-width-modulated signal is controlled using a duty cycle based on logic of exclusive or to provide the non-lighting function without visible effect on the lighting function.

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16. (Amended) A method of providing multiple functions with a lighting device, comprising:

providing a platform,

disposing a first element on the platform, the first element having a lighting function and a first non-lighting function,

disposing a second element on the platform, the second element having a second non-lighting function, and

providing a processor for controlling the first and second elements, wherein the processor generates a pulse-width-modulated signal to control the lighting function.

17. A multifunctional device, comprising:
a platform,
a first element disposed on the platform, the first element having a lighting function,
a second element disposed on the platform, the second element having a non-lighting function,
a third element disposed on the platform, the third element having a non-lighting function different from the function of the second element, and
at least one processor for controlling the first, second and third elements.

18. A method of providing a multifunctional device, comprising:
providing a platform,

providing first element disposed on the platform, the first element having a lighting function,

providing a second element disposed on the platform, the second element having a non-lighting function,

providing a third element disposed on the platform, the third element having a non-lighting function different from the function of the second element, and

providing at least one processor for controlling the first, second and third elements.

19. A method of claim 18, wherein the first element comprises a plurality of LEDs, wherein the non-lighting function is at least one of a communication function, a sensing function, an emitting function and a positioning function.

20. A method of claim 19 wherein the processor controls the elements to perform the non-lighting functions without visible effect on the lighting function.

Please add claims 21-57 as follows:

21. (New) An apparatus, comprising:
at least one LED-based light source configured to generate radiation, the generated radiation including at least visible light to provide illumination; and
a controller coupled to the at least one LED-based light source and configured to control the at least one LED-based light source so as to transmit data via the generated radiation without significantly affecting an appearance of the illumination to an observer.

22. (New) The apparatus of claim 21, further comprising:
at least one receiver configured to receive at least some of the generated radiation and recover the transmitted data from the received radiation.

23. (New) The apparatus of claim 21, wherein the at least one LED-based light source is configured to generate the visible light so as to provide the illumination at a sufficient intensity to effectively illuminate an area.

24. (New) The apparatus of claim 23, wherein the at least one LED-based light source is configured to generate the visible light so as to provide the illumination at an intensity similar to that provided by at least a 25 Watt incandescent light bulb.

25. (New) The apparatus of claim 21, wherein the at least one LED-based light source is configured to generate the visible light so as to provide variable color illumination.

B3 26. (New) The apparatus of claim 25, wherein the controller is configured to control the at least one LED-based light source to both provide the variable color illumination and transmit the data.

27. (New) The apparatus of claim 26, wherein the controller is configured to control the at least one LED-based light source to both provide the variable color illumination and transmit the data via the variable color illumination without significantly affecting the appearance of the variable color illumination to the observer.

28. (New) The apparatus of claim 21, wherein the controller is configured to control the at least one LED-based light source to both provide the illumination and transmit the data via the visible light.

29. (New) The apparatus of claim 28, wherein the controller is configured to control the at least one LED-based light source to transmit the data via at least one predetermined color of the visible light.

30. (New) The apparatus of claim 29, wherein the controller is configured to control the at least one LED-based light source to transmit the data via only one color of the visible light.

31. (New) The apparatus of claim 28, wherein the controller is configured to control the at least one LED-based light source using different time periods to respectively provide the illumination and transmit the data via the visible light.

b3 32. (New) The apparatus of claim 31, wherein the different time periods include alternating time periods to alternately provide the illumination and transmit the data via the visible light.

33. (New) The apparatus of claim 28, wherein the controller is configured to generate at least one control signal to control the at least one LED-based light source using at least a first encoding technique associated with the illumination and a second encoding technique associated with the data to generate the at least one control signal.

34. (New) The apparatus of claim 33, wherein:
the first encoding technique includes pulse width modulation; and
the second encoding technique includes pulse code modulation.

35. (New) The apparatus of claim 34, wherein the controller is configured to generate an intermediate control signal based on the pulse width modulation, and to implement the pulse code modulation to generate the at least one control signal by performing a logic exclusive OR function using the intermediate control signal and a data signal containing the data to be transmitted via the visible light.

36. (New) The apparatus of claim 21, wherein:
the at least one LED-based light source includes:

at least one first LED adapted to generate at least one color of the visible light;
and

at least one second LED adapted to generate radiation having an essentially non-visible wavelength; and

the controller is configured to control the at least one LED-based light source so as to transmit the data via the generated radiation having the essentially non-visible wavelength.

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37. (New) The apparatus of claim 36, wherein the at least one second LED includes at least one infrared LED adapted to generate substantially infrared radiation.

38. (New) An apparatus, comprising:
at least one light source configured to generate radiation, the generated radiation including at least visible light to provide illumination; and
a controller coupled to the at least one light source and configured to control the at least one light source so as to transmit data via at least the visible light without significantly affecting an appearance of the illumination to an observer, the controller being configured to generate at least one control signal to control the at least one light source using a pulse width modulation technique associated with the illumination and a pulse code modulation technique associated with the data to generate the at least one control signal.

39. (New) A method of operating at least one LED-based light source, comprising acts of:

a) generating radiation from the at least one LED-based light source, including at least visible light to provide illumination; and

b) transmitting data via the generated radiation without significantly affecting an appearance of the illumination to an observer.

40. (New) The method of claim 39, further including an act of:

c) receiving at least some of the generated radiation; and

d) recovering the transmitted data from the received radiation.

41. (New) The method of claim 39, wherein the act a) includes an act of:

a1) generating the visible light so as to provide the illumination at a sufficient intensity to effectively illuminate an area.

42. (New) The method of claim 41, wherein the act a1) includes an act of:

generating the visible light so as to provide the illumination at an intensity similar to that provided by at least a 25 Watt incandescent light bulb.

43. (New) The method of claim 39, wherein the act a) includes an act of:

generating the visible light so as to provide variable color illumination.

44. (New) The method of claim 43, further including an act of:

c) controlling the at least one LED-based light source to both provide the variable color illumination and transmit the data.

45. (New) The method of claim 44, wherein the act c) includes an act of:

controlling the at least one LED-based light source to both provide the variable color illumination and transmit the data via the variable color illumination without significantly affecting the appearance of the variable color illumination to the observer.

46. (New) The method of claim 39, wherein the act b) includes an act of:

b1) transmitting the data via the visible light.

47. (New) The method of claim 46, wherein the act b1) includes an act of:

b2) transmitting the data via at least one predetermined color of the visible light.

48. (New) The method of claim 47, wherein the act b2) includes an act of:

transmitting the data via only one color of the visible light.

49. (New) The method of claim 46, further comprising an act of:

c) using different time periods to respectively provide the illumination and transmit the data via the visible light.

50. (New) The method of claim 49, wherein the different time periods include alternating time periods, and wherein the act c) includes an act of:

alternately providing the illumination and transmit the data via the visible light.

51. (New) The method of claim 46, further comprising an act of:

c) generating at least one control signal to control the at least one LED-based light source using at least a first encoding technique associated with the illumination and a second encoding technique associated with the data.

52. (New) The method of claim 51, wherein:

the first encoding technique includes pulse width modulation; and

the second encoding technique includes pulse code modulation.

53. (New) The method of claim 52, wherein the act c) includes acts of:

generating an intermediate control signal based on the pulse width modulation; and

implementing the pulse code modulation to generate the at least one control signal by performing a logic exclusive OR function using the intermediate control signal and a data signal containing the data to be transmitted via the visible light.

54. (New) The method of claim 39, wherein the at least one LED-based light source includes at least one first LED adapted to generate at least one color of the visible light, and at least one second LED adapted to generate radiation having an essentially non-visible wavelength, and wherein the act b) includes an act of:

transmitting the data via the generated radiation having the essentially non-visible wavelength.

55. (New) The method of claim 54, wherein the at least one second LED includes at least one infrared LED adapted to generate substantially infrared radiation.

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56. (New) In a system including at least one LED-based light source configured to generate radiation, the generated radiation including at least visible light to provide illumination, and a controller coupled to the at least one LED-based light source and configured to control the at least one LED-based light source so as to transmit data via the generated radiation without significantly affecting an appearance of the illumination to an observer, a method comprising acts of:

- a) receiving at least some of the radiation generated by the at least one LED-based light source; and
- b) recovering the transmitted data from the received radiation.

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57. (New) A method of operating at least one light source, comprising acts of:

- a) generating radiation including at least visible light to provide illumination;
- b) transmitting data via at least the visible light without significantly affecting an appearance of the illumination to an observer; and
- c) generating at least one control signal to control the at least one light source using a pulse width modulation technique associated with the illumination and a pulse code modulation technique associated with the data.
